A Comparative Analysis of Online Discussion Participation Protocols

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Abstract

Thirty-seven graduate students in two course sections were required to contribute to the online discussion of an instructional design case study. The discussion forums required different participation protocols; students in section one implemented a constructive argumentation approach while students in section two had less structure for their postings. The results revealed that both sections exhibited co-construction of knowledge as measured using the content analysis protocol the Interaction Analysis Model (IAM), but the less structured section reached the highest phase of knowledge building. In addition we found that the constructive argumentation approach and the task-oriented nature of the discussion influenced the interactions and co-construction of knowledge. The findings reveal practical implications for effective design of online discussion that may improve the quality of learning. (Keywords: computer mediated discussions, online discussion protocols, online discussion participation, argumentation.)

INTRODUCTION

With the proliferation of the Internet in our everyday lives, it is not surprising that many universities and K–12 schools have adopted online or Web-based instruction as a delivery method. The National Center for Educational Statistics reported that in 1997–98, 58% of all post-secondary institutions offered Internet-based courses. Further, 82% reported that they had plans to increase their Internet-based offerings over the next three years (NCES, 1999), and the Sloan Foundation's recent report indicates the enrollment growth rate for online courses far exceeds traditional higher education course growth trends (Sloan Foundation, 2004). Although education has progressed to a point where the Internet makes it easy for students to access online resources and tools, it is now important to focus on the online activities that facilitate students' cognitive and metacognitive development.

In many online courses, students are expected to share experiences, negotiate meanings, and construct knowledge within discussion forums. Vygotsky's (1978) socio-cultural theory regards social interaction as an essential cognitive developmental process (Pea, 1996; Salomon, 1988). Therefore, it is not unusual for instructors to require students to engage in collaborative learning activities, which requires social interaction. For discussions in face-to-face (FTF) courses, the instructor can promptly redirect discussions to ensure that underlying assumptions are uncovered and that individual contributions do not ignore what others have said. However, this task becomes more difficult in online courses. If the discussion board contributions lack focus or the board content becomes confusing, then this critical component of an online course can both be an ineffective communication tool and actually impede learning. Hence, determining the appropriate discussion board protocols for participation may have a direct effect on the quality of learning.

A National Education Association poll of distance learning faculty suggests instructors believe that quality learning can occur in these Web-based courses (NEA, 2000), and further research has focused on the importance of the online discussion as a component of Web-based courses (Garrison, Anderson, & Archer, 2001; Harasim, 1989). To examine the quality of online discussions, one can implement content analysis methods to analyze discussion board content (Mazur, 2004; Rourke, Anderson, Garrison, & Archer, 2001). Given the criticality of the online discussion forum to achieving such higher learning outcomes, we examined how having students engage in different discussion board participation protocols—one based on constructing formal arguments and the other not—affected knowledge construction in discussion forum postings.

LITERATURE REVIEW

The basis for our study comes from two literature areas: (a) online discussion forums as an important component of online courses, and (b) the use of argumentation as a means for promoting knowledge construction in online courses. We begin by examining the role of computer-mediated communication as operationalized by the online discussion forum in Web-based courses.

Computer-Mediated Communication

Computer-mediated communication (CMC) refers to asynchronous text-based communication that occurs through "one-to-one, one-to-many, e-mail-based discussion lists, bulletin boards" and computer conferencing environment interactions between computer users (Romiszowski & Mason, 2004, p. 397). CMC has emerged as an important research area in education, psychology, and technology domains (Hara, Bonk, & Angeli, 2000; Romiszowski & Mason, 2004). There are numerous studies that support the idea that interactions with the instructor and other students are essential elements in a Web-based course (Fulford & Zhang, 1993; Picciano, 1998; Sherry, 1996). In discussing online learning, Harasim (1989) describes interactivity as the most striking characteristic of CMC and the factor with the greatest potential to affect learning. Similarly, Garrison, Anderson, and Archer (2001) describe the importance in online learning of creating a "virtual community of inquiry" which allows learners to construct experiences and knowledge through analysis of the subject matter, questioning, and challenging assumptions. In a FTF environment, this kind of reflection is often accomplished via synchronous, interactive discussions and problem solving sessions. The ability to ask questions, share opinions, or disagree with the point of view in a reading assignment is vital to student learning.

The online discussions can play a critical role in Web-based courses by helping learners construct knowledge (Jeong, 2003). In an effective online forum, the discussion encompasses the principles of constructivism and social interactions to help learners reach new insights, knowledge, and perspectives. Principles that demonstrate realistic tasks, scaffolds, and feedback for acquiring skills and knowledge, and collaboration with peers will facilitate the process of constructing a shared body of knowledge (Jonassen, 1999). These outcomes may be

best attained in the forum when appropriate scaffolding is provided within the students' zone of proximal development (Zhu, 1998, as cited in Hara et al., 2000; Vygotsky, 1978). However, empirical evidence to indicate that text-based communication used in computer conferencing can facilitate higher-order and critical thinking is only just emerging and not entirely consistent in its results. For instance, Garrison, Anderson, and Archer (2000) report there is "limited" evidence that CMC can facilitate higher-order thinking. Other studies focus on learner-to-learner interactions in addition to the nature of those interactions (Collins & Collins, 1996; Ravits, 1997; Ward & Tiessen, 1997). These studies all reported that CMC can provide opportunities for more learner-to-learner interaction but also reported that CMC could facilitate more reflective and critical thinking skills.

There is an earlier body of research that is more positive in its description of the potential effect of online forums on meaningful learning. These studies indicated that participation in online forums could lead to broader and deeper participation in group activities (Kiesler, Siefel, & McGuire, 1984; Pullinger, 1986; Spitzer, 1989, as cited in Mazur, 2004). More recently, Jonassen and Kwon (2001) reported that during group problem-solving activities, the CMC participants produced fewer overall but more task-related messages than an FTF group. In addition, the CMC group's decision-making patterns were more sophisticated than that of the FTF group.

Argumentation as a Means of Constructing Knowledge

The basis for the treatment used in this study is founded in social constructivism and the potential knowledge construction benefits of having learners engage in argumentation. Constructivism refers to the belief that knowledge is "actively constructed by learners in response to interactions with environmental stimuli" ("Social Constructivism," 2005). As a particular type of this cognitive constructivism, Vygotsky's (1978) social constructivism is focused on the meaning making that occurs through the role of language and culture (Jonassen & Land, 2000; "Social Constructivism," 2005). A general, albeit non-academic, definition of argumentation is a "heated discussion" or a debate that involves several individuals or parties (Andriessen, Baker, & Suthers, 2003, p. 5). A definition that is aimed at argumentation in academic settings or settings intended to promote learning is based first on the term "argument" where an argument is a "meaningful expression" that is designed to support another utterance or position (Andriessen et al., 2003, p. 6). Argumentation is then defined as a series of arguments that are linked by a common theme or topic. Arguments can be rhetorical—i.e., one sided, where the argument is being used to tell others about a position and convince the ones receiving the argument of the relevance of the position. The transmissive quality of these "arguments" limits their capacity for a true multi-sided discussion that educators hope to promote in online discussion forums. Thus the argumentation activities we review refer to "dialogical" or multi-voiced arguments where different perspectives are being presented and examined and the goal of argumentation is to reach agreement on proposed claims (Driver, Newton, & Osborne, 2000).

Although the benefits of argumentation are not media specific, argumentation is recommended as a means to engage learners in a way that can increase thinking deeply and meaningfully in an online environment (Derry, Levin, Osana, Jones, & Peterson, 2000). Andriessen et al. (2003) offer possible explanations for how argumentation can support such meaningful thinking. They describe argumentation as having the potential to support learning in three different ways: learning from the debate, learning about the debate, and learning to debate. They further propose that the possible explanations for *how* students learn by engaging in argumentation may be based in several activities or processes that occur as part of the argumentation process. First, the actual act of producing arguments or counter-arguments in an interactive context could help the producer to engage in reflection on his or her own position and possibly knowledge restructuring. Second, learning could occur in the form of the acquisition or release of viewpoints as a result of argumentation. Third, learners can engage in knowledge co-construction as a way of reaching compromise between differing views. This phenomenon, which occurs around initial disagreement, can lead learners to hone meanings of concepts being used in the argument (Andriessen et al., 2003).

Various techniques have been devised to support what is known as computer-supported collaborative argumentation (CSCA). Most are based on trying to provide participants with cues (graphic or text-based) on how to create the proper argument structure. One method of supporting argumentation development in online forums is through "constrained" discussion forums.

Constrained or scaffolded discussion forums are pre-structured forms of conversation systems that require participants to label each of their postings from a pre-defined set of message types. For example, Jonassen and Remidez (2005) constrained discussions about a problem by restricting the first-level responses to solutions. Responses to solutions were required to be one of the following: a reason to support, reason to reject, or modify proposal. Any responses to those warrants had to provide evidence, such as information or facts, personal opinion or belief, research findings, and so on. This is in contrast to the standard, non-constrained forum where users may label their messages with a subject heading but there are no enforceable rules that govern their participation. The rules that govern participation in a constrained forum are designed to encourage certain types of thinking by the participants. The most commonly used constraint system supports argumentation, however, a limitless combination of rhetorical structures are possible.

Constrained discussion can support different kinds of reasoning that in turn support more meaningful tasks. Cho and Jonassen (2002) found that using a constraint-based argumentation scaffold positively affected the ability of groups to collaboratively construct arguments in an online environment. Students using the conversation scaffold provided more comments related to problem definition, orientation comments, criteria development, solution development, solution approval, and solution critique.

The potential effects of a constrained forum that implements rules to engage participants in argument construction can be achieved through the use of a regu-

lar (non-constrained) threaded discussion forum in conjunction with a set of rules defined by the facilitator. Jeong and Joung (2004) implemented such "manual" discussion constraints using message labels. One group was required to use a prescribed set of response categories (arguments, evidence, explanation, critique) as scaffolds for the content of their postings in online debates. Another group received the same categories (which were accompanied with explanatory definitions) to guide their posting content and were required to include a corresponding label in their message subject heading; a third group acted as a control. Unlike the graphical tool studies, Jeong and Joung's (2004) study found that message labeling reduced overall debate in the discussion and as a result reduced the proportion of arguments that were elaborated with explanations. Their study provides an important basis for understanding how commonly used threaded discussion tools may be "scaffolded" or "constrained" to affect effective participation in argumentation. The current study continues and expands this line of research.

RESEARCH QUESTIONS

The goal of this research is to compare evidence of knowledge construction from two discussion forums that addressed identical content but used different participation protocols. Consistent with an emerging qualitative methodology (Creswell, 1994), we address the following general research questions so as to not constrain our inquiry: What information, as measured by the IAM, is exchanged among the students? To explore any differences between the participation protocols, two sub-questions guided our study:

- Did social construction of knowledge occur in both forums?
- Did the participation protocols affect knowledge construction and participation?

METHODOLOGY

The study was implemented in an instructional design graduate-level course at a major Midwestern university in the United States. The course was a required component of an online master's curriculum for Educational Technology. Each author taught a course section using the same course materials. Students from both sections retrieved course content and assignments from a single course Web site; however, the two sections participated in separate asynchronous discussion board activities using Blackboard's threaded discussion board tool. There were a total of 37 students enrolled in the online graduate course; 21 in section one and 16 in section two. In section one, there were nine men and fourteen women. Eighteen were pursuing a master's degree and three were PhD students. Section two was composed of four men and twelve women. In section two, there were fourteen students pursuing a master's degree, one PhD student, and one undergraduate.

Instructional Context and Procedures

The course was organized into fifteen weekly themes and topics. Discussion board participation was worth 5% of the final grade and consisted of weekly discussions on the assigned readings, instructional design topics, and case stud-

ies. For the case studies, participants were required to analyze and discuss instructional problems that emphasized one or more aspects of the instructional design process (Ertmer & Quinn, 1999). The case study activity, which was worth 4% of the final grade, required each student to participate on a team that analyzed one assigned case, post three controversial case issues to the discussion board, and facilitate the online discussion for one week. As part of the required discussion board participation, the remaining students debated the lead team's position on the controversial issues.

Instructors for both sections (the researchers) provided identical case study guidelines (see Figure 1) that encouraged students to post substantive analysis and positions that were based on course readings, skills attained during the course, and/or personal research or experiences. The student-led nature of the case studies was designed to promote student knowledge construction and problem solving. Moreover, the cases themselves were intentionally authored to be ambiguous and open to multiple interpretations (Ertmer & Quinn, 1999). Given this, the objectives for the case study activity were for students to apply instructional design principles to each case by arguing for plausible case solutions rather than to acquire new instructional design content knowledge. To scaffold this process, each instructor facilitated a case study discussion in her own section before student-led cases began. Depending on the level of student engagement, the instructors posted messages to help students clarify their ideas and achieve a shared understanding regarding concepts. Although each section used the same content, teams identified and discussed issues that they deemed as important. We did not provide identical issues for each section nor did we prescribe when to scaffold, because we did not want to compromise the student analysis for the sake of research.

Discussion Board Participation Protocols

Protocols that define the rules and guidelines for discussion board participation are important for establishing appropriate discussion board interactions. With protocols, students and facilitators will have common expectations for the quality and quantity of postings. Although the instructors encouraged students to participate in the weekly discussion board activities, they were required to participate in a minimum of seven weekly discussions. For participation in case study discussions, students in both sections were to discuss the controversial issues from the case posted by the instructor or a case study team. All students in both sections were instructed to post comments that were succinct, concise, and add value to the dialogue. Other common guidelines for participation are shown in Figure 2.

Students in section one followed the common guidelines outlined. Students in section two were instructed to follow guidelines designed to help them construct a formalized argument for supporting the positions they were proposing in their postings. Students' postings were to be constructed according to the following categories that are components of arguments (Toulmin, 1958).

Thesis: A thesis is a claim or a proposition to be supported which deals with probability or facts. Every thesis should be followed with evidence for that thesis.

1. Remember that there is no one right answer. As stated by Ertmer & Quinn (1999), "there are many answers... The solutions you propose will depend as much on the perspective you take as on the issues you identify" (p. 3).
2. There is always more than one way to look at a situation. Pay attention to what others have to say (as presented in the case) and how that connects with your perspective.
3. Be open-minded... and suspend judgment until you have considered all the ideas. "Be flexible and open-minded. Remember that problems can be attacked from many different angles" (Ertmer & Quinn, 1999, p. 4). This will be very important when you begin pondering the recommendation(s) and solution(s) with your Design Team.
4. Try to avoid generalizations and extremes. Given the ill-structured nature of the situations in the case studies, it is likely that generalizations will not apply. Look to avoid words like *always*, *never*, *everybody*, or *no one*.

Figure 1. Case Study Guidelines.

1. Before creating a new thread or posting a comment in a forum, make sure that your specific topic or comment has not been posted on the board already.
2. When replying to a posting, rename the subject area so that readers will quickly know your main topic.
3. Although comments should be concise and succinct, comments such as "I agree" are not sufficient.
4. You do not have to "dominate" the conversation to receive credit. Allow others to participate and contribute ideas.
5. Only post comments related to the topic. Electronic mail or the other discussion forums should be used for comments to classmates that do not relate to the weekly topic.
6. You must post comments to the guiding questions in the appropriate forum or thread in order to receive credit.

Figure 2. Rules for participating in the weekly discussions.

Evidence: State a piece of evidence for or against a previously stated thesis.

Assumption: State an underlying assumption either in the thesis put forth, or in response to another posting's thesis or evidence statements.

Synthesis: In this type of posting, one brings together or synthesizes prior postings. Such a posting may include a restatement of theses or evidence or assumptions, and perhaps offer an idea about the thesis that has the most merit, and why (e.g., more evidence).

Students in section two were provided with definitions of each of these parts of an argument and were instructed to label each of their postings as one of the above listed types.

Data Analysis Method

Our analysis methods are based on Chi's (1997) eight-step method for "quantifying qualitative analysis of verbal data" (p. 271). She describes this method of mixing qualitative and quantitative methods as allowing researchers to use qualitative coding methods to capture impressions and trends and then analyze the coded results quantitatively. Her process can be summarized as preparing the qualitative data by deciding on a unit of analysis, choosing or developing a coding scheme and decide what will constitute evidence for each code, applying the scheme and depicting the results using graphs or tables (e.g., coding frequencies), and seeking a pattern or coherence in the data using quantitative methods and interpreting the results and their validity. This method allows researchers a means to systematically produce quantitative results from an underlying qualitative coding of verbal or transcript data. Chi indicates that this methodology is most appropriate when the goal of the analysis is to "formulate an understanding of the representation of the knowledge used in cognitive performances and how that representation changes with learning" (p. 271).

Our application of this method began by choosing to analyze the student-facilitated discussion board content for four weeks where the two sections operated using different participation protocols. For the weeks analyzed, students in section two had been instructed to use the "argumentation" format for postings and had in fact already applied these guidelines in prior weeks' discussions.

Our decision on the unit of analysis is described below and was directly tied to the choice of a coding scheme. Because we wished to gather evidence of knowledge construction in both groups, we chose to apply the Interaction Analysis Model (IAM) (Gunawardena, Lowe, & Anderson, 1997) to the discussion board transcripts. The IAM is based on a constructivist paradigm designed to detect evidence of knowledge construction, and was developed in an attempt to further understand and describe the processes of negotiating meaning and knowledge co-construction in a collaborative online discussion environment (Gunawardena et al., 1997)—both processes described by Andriessen et al. (2003) as being components of argumentation that may promote learning. Gunawardena et al. posited that when knowledge is being constructed, learners move through five phases (not necessarily sequentially). Table 1 provides a description of the IAM phases.

Using the IAM, results of coded transcripts are categorized into these five phases to provide a distribution that indicates the degree of knowledge construction activities. This distribution amongst the five phases provided the basis for Chi's (1997) step of "depicting the results." This model has since been used in studies by other researchers (Beaudrie, 2000; Kanuka & Anderson, 1998; Marra, Moore, & Klimczak, 2004; Schellens & Valcke, 2003). Given the lack of consistently adopted online content analysis models (Mazur, 2004), even this relatively small track record makes the IAM one of the most frequently used online content analysis models currently available. Not only is the IAM "well used," it is also appropriate for our research questions because it detects knowledge construction; thus it is a good choice for our work.

Table 1: Interaction Analysis Model (IAM) (Gunawardena, Lowe, & Anderson, 1997)

Phase	Attributes
Phase I: Sharing/comparing of information	Statements of observation or opinion; statement of agreement between participants.
Phase II: Discovery and exploration of dissonance or inconsistency among ideas, concepts, or statements	Identifying areas of disagreement; asking and answering questions to clarify disagreement.
Phase III: Negotiation of meaning/ knowledge co-construction	Negotiating meaning of terms and negotiation of the relative weight to be used for various arguments.
Phase IV: Testing and modification of proposed synthesis or co-construction	Testing the proposed new knowledge against existing cognitive schema, personal experience, or other sources.
Phase V: Phrasing of agreement and applications of newly constructed meaning	Summarizing agreement and metacognitive statements that show new knowledge construction.

Each author separately coded the forum transcripts using the codes/phases as defined in the IAM protocol (see Table 1)—thus our decisions as to what utterances constituted evidence of each phase were based on the examples and explanations from the original IAM authors. To apply the IAM, the authors read each posting in the original sequence and applied an IAM phase or phases. In most cases, the authors coded multiple sentences, or a paragraph or two with a single phase; this use was consistent with the original application of the IAM (Gunawardena et al., 1997). Because many postings contained multiple paragraphs and addressed several topics, in many cases the authors assigned two or more phases to a single posting.

To conduct inter-rater reliability checks, we adopted the convention based on prior research using this protocol (Beaudrie, 2000) to use the most advanced phase from each posting as the basis for inter-rater checks. Hence, the unit of meaning became the entire posting, rather than phrases, sentences, or paragraphs within the posting. Given the developmental nature of this protocol (Gunawardena et al., 1997) and that the highest levels of advancement of knowledge construction is directly implied by the most advanced phases, this convention seems both logical and viable.

Although the IAM phases are clearly defined, applying the phases to the appropriate content required the authors to address the underlying meaning represented in the postings. Researchers have indicated that accounting for latent variables is somewhat subjective and depends on the rater's interpretation, which is in contrast to identifying manifest variables that are easily observable (Rourke et al., 2001). For example, Phase III (see Table 1) uses "relative weight" as a variable for this phase, but it can have multiple indicators, such as "this is

important because…" or "I feel that it should be…" We addressed this potential threat to reliability using our inter-rater checks during and after individual coding for our first data set (i.e., Week 6). To complete our application of the Chi (1997) methods, we conducted inter-rater coding checks for the remaining three data sets and organized the resulting frequencies into tables for interpretation. These results are described in the next section.

Another data source was summative student feedback regarding the course activities. During the last week of the semester, the students posted their evaluations of the effectiveness of their assignments and the weekly discussions—to provide a summative evaluation as well as formative data that would be applied to the next iteration of the course.

RESULTS

For the four case studies analyzed in both sections, the discussions included 280 postings from students and instructors. Twenty-eight postings (10% of the total) were not coded because the posting in question was a lead team's case solution, a student posting submitted to the wrong discussion thread, an exact duplicate of a prior posting, or an instructor posting describing participation guidelines. In all of these situations, the posting was not intended to contribute to knowledge construction, which was the focus of the current analysis. Of the remaining 252 postings, 177 postings were from section one and 72 postings were from section two. When examining the quantity of postings, there were obvious differences between the sections. The mean number of postings for case studies was 44.2 (SD= 9.63) for section one compared to 18 (SD=8.4) for section two. Table 2 provides a summary of the section differences.

To compute inter-rater reliability figures, we followed the method delineated by Chi (1997), which requires that the raters categorize coding differences as either resolved, or in the instance of strong rating opinions by multiple raters, as unresolved. Table 3 reflects the resolved codings for section one. Week 6 was the first set of postings that we coded and it was the only week where the authors did not reach complete inter-rater agreement. The three postings where a strong disagreement remained amongst the authors were distributed amongst Phases I–III, which are also the three most frequently used phases (92%) for the agreed upon postings within each case discussion. Krippendorff's (1980) reliability formula produced a coefficient of 61% for initial codes and 93% for codes after reliability discussions. The Cohen's kappa coefficient was also 61%, which represents a moderately strong agreement rate (Landis & Koch, 1977; Kvalseth, 1989) based on three assumptions: (1) the units of analysis are independent, (2) the categories are mutually exclusive, and (3) the raters are operating independently (Cohen, 1960)[1].

[1] Although our inter-rater coefficient is on the lower edge of acceptability, these results can be partially explained by the raters having to *interpret* another researcher's category definitions. Many content analysis researchers develop their own coding scheme, which allows the researchers to have a complete understanding of how to apply codes.

Table 2: Discussion Board Participation Metrics by Section

Participation Protocol	Section 1 Basic	Section 2 Constructive Argumentation
Number of Students	21	16
Case Studies		
Case Study 1 Postings (Week 4)	31	23
Case Study 2 Postings (Week 6)	45	27
Case Study 3 Postings (Week 12)	47	13
Case Study 4 Postings (Week 13)	54	9
Total Case Study Postings	177	72
Mean Case Study Postings	44.2 (SD=9.63)	18 (SD=8.4)
Mean number of students participating	13 (~62%)	10 (62%)
Mean number of facilitators	5	3.75
Mean number of student facilitator postings	21.2	4.2
Mean number of Instructor/TA postings	2	3.2
All Weekly Discussions		
Mean number of discussion board postings for case studies and other weekly topics	34.5 (SD=21.31)	16.9 (SD=10.96)
Mean number of students participating per week	9 (46%)	8 (50%)

Table 3: IAM Ratings for Section One, Basic Posting Requirements

	Phase I	Phase II	Phase III	Phase IV	Phase V	Totals
Week 4	13	12	5	0	1	31
Week 6	11	16	14	4	0	*45
Week 12	23	7	16	0	1	47
Week 13	20	11	18	5	0	54
Totals	67	46	53	9	2	177
	(37%)	(26%)	(29%)	(5%)	(1%)	(~98%)

** Based on total of 48 coded postings, including 3 where inter-rater agreement could not be reached.*

The results from section two also reflect Phases I–III as the three most frequently used phases for the agreed upon postings (see Table 4, page 202) with 97% of coded postings falling in these three phases. The reliability coefficient for post-inter-rater reliability discussions was 100%. In contrast to section one, there were no postings coded at Phase V.

We performed a Chi square analysis on the phase totals for each section. Due to low cell counts, we collapsed the Phases III–IV into one category because they all represent a type of knowledge construction. Chi-square analysis showed that the frequency differences between the two sections were significant (X^2 (2, N=249) = 7.11) at the p <.05 level.

Table 4: IAM Ratings for Section Two, Constructive Argumentation Requirements

	Phase I	Phase II	Phase III	Phase IV	Phase V	Totals
Week 4	13	5	5	0	0	23
Week 6	9	7	9	2	0	27
Week 12	11	2	0	0	0	13
Week 13	7	2	0	0	0	9
Totals	40	16	14	2	0	72
	(56%)	(22%)	(19%)	(3%)		(100%)

DISCUSSION

Evidence of Knowledge Construction

The distribution of our coded results in the IAM phases indicates that participants in both sections were engaged predominantly in activities exploring agreement (Phase I), discovering or exploring dissonance or inconsistencies (Phase II), or engaging in the negotiation of meaning or knowledge co-construction (Phase III). These results are slightly different than prior research using this protocol (Beaudrie, 2000; Kanuka & Anderson, 1998; Marra et al., 2004) where the preponderance of postings represented either Phase I or II. As defined by the IAM phases, knowledge construction and negotiation of meaning occurs at Phases III and above. Both sections showed evidence of knowledge construction, with 29% of section one postings (see Table 3) and 19% of section two postings (see Table 4) occurring in Phase III. As noted previously, very few postings in either section were coded in Phases IV or V.

Effect of Participation Protocols

The effect of the differing discussion board participation protocols as measured by evidence of knowledge construction can be examined from several different perspectives. We begin with examining the differences in all five IAM coded phases and then turn to the differences in the IAM knowledge construction phases, and then conclude with a discussion of how participation quantity may have been affected by the participation protocols.

Differences in IAM Coded Phases. The Chi-square analysis showed a significant relationship between the participation protocol and the IAM phases (X^2 (2, N=249) = 7.11) at $p < .05$ with students in section one (the non-argumentation discussion board protocol) having both more coded postings and more postings at higher phase levels. Given the rather small frequencies, this finding is noteworthy. We discuss the possible explanations for these differences below and posit that they are related to an unexpected effect of the argumentation discussion protocol.

There are also strong similarities between the distributions of the coded phases for each section—particularly for the first three phases. In section one, a total of 166 (92%) coded postings were in Phases I–III. Similarly in section two, 70 coded postings (97%) were in the first three phases.

Differences in Knowledge Construction Phases. As seen in Tables 3 and 4, there was evidence of co-construction of knowledge for both sections, however Phase V was only evident in section one. This may be caused by the nature

of the discussion board task and/or the participation protocol. Regarding the discussion board task, having students respond to controversial issues defined by student facilitators regarding an instructional design case may not allow students to reflect upon and apply what they have learned because the discussion requires them to only focus on the presented issues. Students were asked to agree or disagree with the controversial statements. For both sections this may have inhibited students from moving beyond the "agree or disagree" phase to one where knowledge construction can occur and thus affected the distribution of Phases III–V ratings.

A student indicated "I had a hard time working with a structured discussion board at first and didn't get as much out of posting to another team's case study as I did when we moderated the discussion ourselves." This statement reflects two issues. One, students were constrained to the controversial issues presented by the student-led facilitators, and these in turn may have been affected by the content of the case. Two, the student-facilitators may have been the only ones to really construct and apply new knowledge. Because each case was assigned to student teams, the second issue is actually a positive outcome of the team assignment. When students take more responsibility for leading discussion, they take more ownership of their learning. Similar to creating instruction, students were learning more when they were in charge of "leading" others or defending their analysis.

The constructive argumentation protocol includes a "synthesis" type of postings, but this was not practiced by any of the participants in section two. Similar to our research, Gunawardena et al.'s (1997) findings revealed that a debate format and the "task-oriented" nature of the discussion influenced the interactions and affected the co-construction of knowledge, both in a positive and negative manner.

Participation Quantity. Even when one accounts for the differences in the section sizes (21 versus 16), there were clear differences between the number of postings and participation rates for the two sections. For student-facilitated case discussions, the average number of postings was 44 for section one and 18 for section two. Over half of the students consistently participated during the case studies for section one, but there was a dramatic reduction toward the end of the semester for section two. Students in section two were active for the first two case studies (~81%), but only 56% and 31% participated for the third and fourth case, respectively. Recall that students in both sections were required to participate actively in seven forums to earn full credit for the discussion forum part of the course. By the time cases three and four were discussed (weeks 12 and 13 of the 15-week semester), many students may have met this requirement and thus may have focused on the large, high-point-value instructional design projects that they were completing at that time. However plausible and practical, this situation was true for both sections one and two and thus does not account for the differences in participation between the two sections. Thus, we turn to other explanations that may account for these differences in participation quantity – and some of which may also explain the differences in participation quality described previously.

The nature of the discussion board protocol for section two is an obvious possible explanation for both the participation quantity and quality. The argumentation protocol used in section two required students to formulate their postings in one of five types (thesis, evidence for, evidence against, assumption, and synthesis), where each type mapped to a part of a formal argument. In her written feedback about the course at the end of the semester, one student described how the format affected her participation:

> I enjoyed the case studies—I seemed to get hung up on the correct method of discussion sometimes, instead of focusing on the meat of the case. I might have submitted more if I were more secure in the proper method of submission. The case studies seemed to make the meaning of instructional design more clear.

Although students may have experience with online courses and participating in online forums, it appeared that they did not have experience with constructing an argument. Even though the section two instructor implemented a "practice" discussion with students using the protocol and also provided facilitative feedback on their use of the protocol, students may still have found the required protocol difficult to implement. Additionally, although argumentation is an essential skill for many problem-solving activities (Jonassen & Remedez, 2005), the argumentation protocol may not have been well suited for the case analysis task. Evidence for this explanation is that there were fewer postings in section two discussions. Furthermore, the authors noted during their analysis that section one postings often contained several different ideas associated with the controversial issue the student was discussing. For instance, in the following excerpts from a Phase III posting from the fourth case study, this section one student addresses the role of the instructional designer relative to the client and subject matter experts (paragraphs 1 and 3), the poster's relevant personal experience on designing curriculum (paragraph 2), and the issue of platform compatibility that was a key aspect of the case (paragraph 4).

> Clients depend upon the instructional system designer to provide an educational or training product that not only meets their needs "now" but at least for the foreseeable future. In addition, there are a number of aspects of system design about which subject matter experts have little knowledge and therefore depend upon the instructional system designer for expertise.
>
> I recently had occasion to provide consultation on a project in which an entire curriculum of 8 courses had been created. For these online courses, all lectures were in digital audio format—no text alternative. Of course, this format explicitly restricted access to the lectures by those students with a hearing impairment.
>
> Regardless of one's perspective concerning a given platform, I argue that it is incumbent upon the instructional system designer to understand the broader implications of the final instructional product and the constraints imposed by institutional policy, the law, technol-

ogy, and the zeitgeist—and to bring this knowledge to bear on a given instructional product. Otherwise, it seems to me, we are just programmers and frankly—what's the use?

By the way, 5 years ago Apple Computer was in the worst financial condition in its history having lost some $68 million in the last quarter of 1996. It wasn't until 2 years later (1997 approximately) that the company began its current upswing … Surely, Nguyen was aware of this fact when she considered the development of the instructional product.

If a student in section two had wished to post similar ideas, that student would have needed to determine how to "parse" all of these individual ideas into the required message types of the constructive argumentation protocol. This extra effort may have led students in section two to be somewhat stifled in their postings—which could in turn lead to fewer postings, lower overall participation rates, and potentially lower motivation to participate in the forums. The last idea is supported by the student's comment that "I might have submitted more if I were more secure in the proper method of submission." Further support for this explanation comes from prior work from Jeong and Joung (2004). The researchers found that when students participating in an online forum were required to pre-classify their messages with response headings, those students participated in the forum to a lesser degree than the control group and also showed less evidence of engaging in argumentation—which was the intent of the message labeling activity.

Other explanations not directly linked to the protocol are also possible. For instance, one may propose that the actual content of the different cases may have affected both the quantity and quality of the participation we observed; however, given the nature of the differences we saw between the sections in each individual case, this seems a less likely explanation. Another explanation could be that some students were better facilitators than others, which can affect the quantity and quality of postings. The challenge for facilitators is to demonstrate appropriate, relevant, and timely responses that bring attention to important ideas and make linkages to other postings (Garrison & Anderson, 2003). During our analysis, we coded facilitator postings as Phase ID, because they reflected probing questions that clarified or directed the discussion. Our results indicate a considerable difference in the number of student facilitator postings. (See Table 2.) We recognize that a facilitator analysis would provide a different lens for examining the data and could contribute to understanding the quantity and quality of postings; however the focus of our analysis was the evidence of knowledge constructing and not the facilitator methods for encouraging discourse among the students.

The lower enrollment in section two may have contributed to the overall lower participation rates. Excluding the student facilitation team, there were only a maximum of 12 students to debate the case's controversial issues. With this relatively small number of students distributing their postings over three different controversial issues, this may have resulted in both less in-depth analysis of any single issue as well as an overall lower number of postings and lower partici-

pation rates. In short, with so few students, it may have been difficult to build up the needed momentum to hold an active and engaging discussion. This potentially affected participation rates and the degree to which knowledge construction occurred in section two. If a smaller number of students' participation is distributed over the three or more controversial issues posted for each case, it may have been less likely that the discussion of any one of the controversial issues would build enough for the students to engage in meaning making and knowledge co-construction activities (e.g., IAM phases III and higher).

This problem may have been exacerbated in the last two cases, when some student may have reached their required discussion participation. Once the seven weekly participations were met, students did not feel obligated to participate in discussions. In section one, this effect may not have been so pronounced, as there were more students that could have spread their participation throughout the semester. This is particularly plausible because of the "non-redundancy" requirement. (See Figure 1.) Section one students may not have had the opportunity to post at the beginning because they waited too late and most of the appropriate and relevant ideas had already been posted.

The question of how often students should participate depends on the objective of the activity and in this case, the number of students. One could implement a strategy to separate students into smaller groups and discuss the same topic, but this requires more management for the instructor and students in each group might miss out on important ideas from the other group. In their end-of-semester comments, many students indicated that they liked the ability to choose when to participate. One student commented about not having to post every week:

> I for one appreciate your view of the discussion board as a support for the class. Like Bob, I am also enrolled in another class that demands a great number of postings to the discussion board each week. While I enjoy reading others' views and feel that the interaction is very valuable, I want to post when I feel that I have something to add to the discussion or have a question. I don't like having to post just to meet a quota each week.

Another student noted that decreasing the amount of participation meant "less fluff and less clicking on meaningless post-just-to-submit posts." Research from Bodzin and Park (2000) supports this explanation, as they found the possibility of a saturation effect when a large number of students are required to respond to a single problem. With 32 students responding in one week, Bodzin and Park (2000) discovered that many students were not reading other postings, and were posting to meet the requirements. The implications of our findings and other research support participation strategies that allow flexibility for students to choose when to contribute to discussions.

CONCLUSIONS AND RECOMMENDATIONS

This study examined the effect of differing discussion board participation protocols on evidence of knowledge construction as measured by the IAM using following research questions:

- Did social construction of knowledge occur in both forums?
- Did the participation protocols affect knowledge construction and participation?

The argumentation protocol that was designed to facilitate knowledge construction in section two did not show evidence of having that effect. In fact, our findings show that there were overall fewer postings in section two, a lower number of postings in Phases III and above, and that the overall level of interactions in this section was lower than in section one. Our discussion notes that some of these differences may be due to the smaller number of students in section two, but student comments and prior research (Jeong & Joung, 2004) indicate that the argumentation protocol, as we implemented it, may have negatively affected students' quantity and quality of participation. These results suggest the following implications for researchers and instructors for the discussion forums in online courses.

Discussion Board Tasks and Participation

When instructors are creating discussion board activities for online courses, at least two questions must be answered. First, what is the objective of the discussions? Different objectives might be to create a "social presence" among students so that they do not feel isolated, to ask questions regarding assignments or topics, or to determine if students understand a topic by having them analyze and evaluate contextual situations. Based on the response to this question, different rules might be implemented to focus on the quality of the interaction more so than the quantity. The second question is, how important is online discussions in comparison to the other activities that students will perform? This question alludes to the amount of participation that instructors expect from students in online discussions along with the other required activities for the course. If a small percentage of student effort is designated for class participation, our results show that it can affect the quality and quantity of interactions.

For our course, the minimum participation quantity affected the number of people that contributed each week. This can be viewed as positive and negative. For students that did not really have anything to contribute, they did not post redundant or disjointed comments to the discussion board in order to meet the requirements. On the other hand, if there is not 100% class participation, then it might lessen the co-construction of knowledge: someone may be able to contribute, but will not because he/she has met the requirements and there is a greater need to focus on other activities. Therefore, we recognize that it is good to have options when it does not decrease the active participation. This becomes even more critical when you have online classes with small enrollments, such as less than 15 students. When it is more than 15, this strategy would probably be more effective. By balancing the number of required discussion participations during the semester with the other course activities, students might be able to provide more meaningful and "thought-provoking" discussions when they do participate. Thus, instructors need to determine how often students must participate in order to meet the learning objectives.

Regarding the facilitation of the discussions, some student facilitators were more aggressive in moving the discussion to a consensus than others. Facilitator efforts may have been hampered by requirements to post all of the issues at the beginning of the discussion. To have more evidence of synthesis and application of newly constructed meaning (i.e., Phases IV and V), we believe that focusing on one issue at a time rather than introducing another one will assist with reaching higher phases. Another strategy would be to impose a time limit for each issue, such as two days, to improve timely involvement. As many discussion board participants have experienced, it can be difficult to get reacquainted with a discussion after several days have passed. Thus, a different time period for each issue may contribute to more meaningful discussions. Research examining variables for time lengths, day of the week, and number of participants along with facilitation methods might provide strategies for increasing participation without compromising the quality of participation.

Participation Protocols

Further research is needed to investigate the effect of participation protocols with different discussion board activities. Our findings are limited by the small class size for section two in comparison to section one. Also, the investigation of participation protocols needs to include interventions that are more "structured" for requiring students to use certain types of postings at different stages of the discussion. Our argumentation approach was a self-imposed structure and the course management system (Blackboard) offered no support for the protocol. However, researchers and practitioners now have access to discussion board software packages that directly support instructor-defined protocols for discussion forums, including CaMILE (Guzdial, 1995), Belvedere (Suthers, & Hundhausen, 2001), and CSILE (Scardamalia & Bereiter, 1994). Thus, further research using participation protocols implemented in these packages may provide students with an externally defined structure that will facilitate their better use of the protocol.

Lastly, our results indicate that in designing discussion board activities and protocols for participation, instructors must try to ensure that the participation protocol is in alignment with the task and intended objectives of the discussion board task. Although argumentation has been shown to facilitate higher-order thinking and learning outcomes (Andriessen, et. al. 2003; Jonassen & Remedez, 2005), applying an argumentation protocol to the task of discussing controversial issues in the instructional design case studies may have been a mismatch between the requirements of the case study task (agreeing or disagreeing with controversial issues) and the cognitive skills necessary to build a meaningful argument. Software tools for implementing discussion boards with externally defined participation protocols, or constrained discussion forums, can allow researchers to examine the relationships between different types of participation protocols and discussion board tasks and accompanying learning outcomes that produce the most effective learning. Additionally, further research such as the current study using more commonly available discussion tools may also further the communities' understanding of how to promote meaningful learning

through online forums. Although our results indicate that our case study task did not mesh will with an argumentation protocol, one should not conclude that argumentation may not promote knowledge construction when paired with a different discussion board task.

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References

Andriessen, J., Baker, M., & Suthers, D. (2003). Argumentation, computer support, and the educational context of confronting cognitions. In J. Andriessen, M. Baker, & D. Suthers (eds.), *Arguing to Learn: Confronting Cognitions in Computer-Supported Collaborative Learning Environments,* (pp. 1–25), Boston: Kluwer Academic Publishers.

Beaudrie, B. P. (2000). *Analysis of group problem-solving tasks in a geometry course for teachers using computer-mediated conferencing.* Unpublished EdD thesis, Montana State University, Bozeman.

Bodzin, A. M., & Park, J. C. (2000). Dialogue patterns of preservice science teachers using asynchronous computer-mediated communications on the World Wide Web. *Journal of Computers in Mathematics and Science Teaching, 19*(2), 161–194.

Chi, M. T. H. (1997). Quantifying qualitative analyses of verbal data: A practical guide. *The Journal of the Learning Sciences, 6*(3), 271–315.

Cho, K. L., & Jonassen, D. H. (2002). The effects of argumentation scaffolds on argumentation and problem solving. *Educational Technology: Research & Development, 50*(3), 5–22.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, *20*, 37–46.

Collins, C., & Collins, S. (1996). *The Internet as a tool.* Call of the North, NECC '96. Proceedings of the Annual National Educational Computing Conference. (ERIC Document Reproduction Service No. ED 398883)

Creswell, J. W. (1994). *Research Design: Qualitative & Quantitative Approaches*. Thousand Oaks, CA: Sage.

Derry, S. J., Levin, J. R., Osana, H., Jones, M. S., & Peterson, M. (2000). Fostering students' statistical and scientific thinking: Lessons learned from an innovative college course. *American Educational Research Journal, 37*(4), 747–773.

Driver, R., Newton, P., & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education, 84*(3), 287–312.

Ertmer, P. A., & Quinn, J. (1999). *The ID casebook: Case studies in instructional design*. Upper Saddle River, NJ: Prentice Hall.

Fulford, C. P., & Zhang, S. (1993). Perceptions of interaction: The critical predictor in distance education. *The American Journal of Distance Education*, *7*(3), 8–21.

Garrison, D. R., & Anderson, T. (2003). *E-learning in the 21st Century*. New York: RoutledgeFalmer.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education, 2*(2/3), 87–105.

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education, 15*(1), 7–23.

Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research, 17*(4), 397–431.

Guzdial (1995). Software-realized scaffolding to facilitate programming for science learning. *Interactive Learning Environments, 3*(4), 1–44.

Hara, N., Bonk, C. J., & Angeli, C. (2000). Content analysis of online discussion in an applied educational psychology. *Instructional Science, 28*(2), 115–152.

Harasim, L. M. (1989). Online education as a new domain. In R. Mason & A. R. Kaye (Eds.), *Mindweave: Communication, computers and distance education* (pp. 50–62). Oxford: Pergamon Press.

Jeong, A. (2003). Sequential analysis of group interaction and critical thinking in threaded discussions. *The American Journal of Distance Education, 17*(4), 397–431.

Jeong, A. & Joung, S. (2004). *The effects of response constraints and message labels on interaction patterns and argumentation in online discussions.* Paper presented at the annual meeting of the American Educational Researchers Association, San Diego, CA.

Jonassen, D. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.) *Instructional-design theories and models*: *A new paradigm of instructional theory* (Vol 2, pp. 215–239). Mahwah, N.J.: Lawrence Erlbaum Associates.

Jonassen, D. H., & Kwon, H. (2001). Communication patterns in computer mediated versus face-to-face group problem solving. *Educational Technology Research and Development, 49*(1), 1042–1629.

Jonassen, D. H., & Land, S. M. (2000). Preface. In D. H. Jonassen & S. M. Land (Eds.), *Theoretical foundations of learning environments,* (pp. iii–ix). Mahwah, NJ: Lawrence Erlbaum Associates.

Jonassen, D. H., & Remidez, H. (2005). Mapping alternative discourse structures onto computer conferences. *International Journal of Knowledge and Learning, 1*(1/2), 113–129.

Kanuka, H., & Anderson, T. (1998). Online social interchange, discord and knowledge construction. *Journal of Distance Education, 13*(1), 57–74.

Kiesler, S., Siefel, J., & McGuire, T. (1984). Social psychological aspects of computer-mediated communication. *American Psychologist, 39*, 1123–1134.

Krippendorf, K. (1980). *Content Analysis: An Introduction to Its Methodology.* Vol. 5. The Sage COMMTEXT Series, Beverly Hills, CA: Sage Publications.

Kvalseth, T. O. (1989). Note on Cohen's kappa. *Psychological Reports, 65*, 223–226.

Landis, J., & Koch, G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*, 159–174.

Marra, R. M., Moore, J. L., & Klimczak, A. (2004). A comparative analysis of content analysis protocols for online discussion forums. *Educational Technology Research and Development, 52*(2), 23–40.

Mazur, J. (2004). Conversation analysis for educational technologists: Theoretical and methodological issues for researching the structures, processes and meaning of online talk. In D.H. Jonassen (Ed.), *Handbook for research in educational communications and technology,* (2nd ed, pp. 1073–1098). Hillsdale, NJ: Lawrence Erlbaum Associates.

National Education Association. (2000). *Confronting the future of distance learning—Placing quality in reach.* Retrieved March 26, 2004 from http://www.nea.org/nr/nr000614.html.

National Center for Educational Statistics. (1999). *Distance Education at Postsecondary Education Institutions* (Statistical Analysis Report NCES 2000–013). Washington, DC: Office of Educational Research and Improvement.

Pea, R. D. (1996). Seeing what we build together. Distributed multimedia learning environments for transformative communications. In T. Koschmann (Ed.), *CSCL: Theory and practice of an emerging paradigm* (pp. 171–186). Mahwah, NJ: Lawrence Erlbaum Associates.

Picciano, A. G. (1998). Developing an asynchronous course model at a large, urban university. *Journal of Asynchronous Learning Networks*, *2*(1). Retrieved March 21, 2004, from http://www.aln.org/publications/jaln/v2n1/v2n1_picciano.asp.

Pullinger, D. J. (1986). Chit-chat to electronic journals. Computer conferencing supports scientific communication. In V. Arms (Ed.) *IEEE transactions of professional communications*, (PC29, 30–33).

Ravits, J. (1997). An ISD model for building online communities: Furthering the dialogue. In O. Abel, N. Maushak, & K. Wright (Eds.), *Selected research and development presentations at the annual meeting of the Association for Educational Communications and Technology* (pp. 297–307). Bloomington, IN: AECT.

Romiszowski, A., & Mason, R. (2004). Computer-mediated communication. In D. H. Jonassen (Ed.), *Handbook for research in educational communications and technology, 2nd Edition*, (pp. 397–432). Mahwah, NJ: Lawrence Erlbaum Associates.

Rourke, L., Anderson, T., Garrison, R., & Archer, W. (2001). Methodological issues in the content analysis of computer conference transcripts, *International Journal of Artificial Intelligence in Education, 12*(x), 8–22.

Salomon, G. (1988). AI in reverse: Computer tools that become cognitive. *Journal of Educational Computing Research*, *4*, 123–140.

Scardamalia, M., & Bereiter, C.(1994). Computer support for knowledge-building communities. *The Journal of the Learning Sciences, 3*(3), 265–283.

Schellens, T., & Valcke, M. (2003). *Collaborative learning in asynchronous discussion groups: the impact on cognitive processing.* Paper presented at the Annual Meeting of the American Education Research Association, Chicago, IL.

Sherry, L. (1996). Issues in distance learning. *International Journal of Distance Education*, *1*(4), 337–365.

Sloan Foundation (2004). *Entering the mainstream: The quality and extent of online education in the United States 2003 and 2004*. Retrieved November 28, 2004, from http://Sloan-c.org/resources.

"Social Constructivism." (2005). Retrieved April 15, 2005, from the University of California at Berkeley Graduate Student Instructor Teaching & Resource Center Web site: http://gsi.berkeley.edu/resources/learning/social.html.

Spitzer, M. (1989). Computer conferencing: An emerging technology. In G. Hawisher & S. Selfe (Eds.), *Critical perspectives on computers and composition instruction* (pp. 187–199). New York: Teachers College Press.

Suthers, D. D., & Hundhausen, C. D. (2001). Learning by constructing collaborative representations: An empirical comparison of three alternatives. In P. Dillenbourg, A. Eurelings, & K. Hakkarainen (Eds.), *European perspectives on computer-supported collaborative learning* (pp. 577–584). Universiteit Masstricht.

Toulmin, S. (1958). *The uses of argument*. Cambridge: University Press.

Vygotsky, L. (1978). *Mind in society*. Cambridge, MA: Harvard Press.

Ward, D. R., & Tiessen, E. L. (1997). Adding educational value to the Web: Active learning with a live page. *Educational Technology, 37(5)*, 22–31.

Zhu, P. (1998). Learning and mentoring: Electronic discussion in a distance learning course. In C. J. Bonk & K. S. King, (Eds.), *Electronic collaborators: Learner-centered technologies for literacy, Apprenticeship, and Discourse*, (pp. 233–259). Mahwah, NJ: Erlbaum.